AMENDMENT UNDER 37 C.F.R. § 1.312
U.S. Appln. No. 09/610,476

REMARKS

The changes being made are simply editorial in nature and no question of new matter or questions of further search arise.

Entry and consideration of this Amendment is respectfully requested.

Respectfully submitted,

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APPENDIX

VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE SPECIFICATION:

#5

The specification is changed as follows:

Page 1, second full paragraph:

Rare earth sintered magnets put into practical use are produced by pulverization of an alloy, molding, sintering, heat treatment and machining, and further surface treatment, if necessary. Among them, R-T-B-based rare earth sintered magnets having $R_2T_{14}B$ intermetallic compounds, wherein R is at least one [of] rare earth [elements] element including Y, and T is Fe or Fe and Co, as main phases are widely used as high-performance magnets. However, alloy powder is rapidly oxidized in the air, resulting in deterioration in magnetic properties. In extreme cases, rapid oxidation leads to ignition, posing safety problems.

Page 3, first full paragraph:

However, when thin (or thin and long) green bodies for [an] arc-segment-shaped, R-T-B-based sintered magnets are formed by compression molding in a magnetic field under the conditions described in EXAMPLE 12 of Japanese Patent Laid-Open No. 7-37716, remarkable cracking occurs. Even when green bodies without cracking are obtained, they have an extremely uneven density distribution, resulting in largely deformed sintered bodies, leading to largely deformed sintered bodies poor in orientation, [failing to] and cannot be put [them] into practical use.

Page 3, paragraph bridging pages 3 and 4:

When radially anisotropic, R-T-B-based, sintered ring magnets (hereinafter referred to as radial rings) or arc segment magnets are formed under the conventional production conditions described in Japanese Patent 2,859,517, [an] a radially orienting magnetic field should be applied from the inner surface side to the outer surface side of a cavity of a molding die in the course of molding to impart radial anisotropy to the green bodies, posing the problem that the smaller the inner diameter of a cavity, the weaker the radially orienting magnetic field. Thus, the smaller the inner diameters of radial rings, the poorer the radial orientation of green bodies. In actuality, if an orientation (static) magnetic field or more than 795.8 kA/m (10 kOe) can be applied in a radial direction for several seconds, it would be possible to obtain substantially the same level of radial orientation as the orientation of R-T-B-based sintered magnets formed though a molding step in a transverse magnetic field or a vertical magnetic field. However, in the industrial production of radial rings of 10-100 mm in inner diameter, the radially orienting magnetic field applied at the time of molding is as low as about 238.7-795.8 kA/m (3-10 kOe).

Page 4, second paragraph:

Also, [an] a radially orienting magnetic field applied during a molding step of radially anisotropic, R-T-B-based sintered arc segment magnets in usual industrial production is as low as about 238.7-795.8 kA/m (3-10 kOe). Thus, like radial rings, the problem of poor radial orientation occurs in the case of R-T-B-based, sintered arc segment magnets of 100 mm or less in inner diameter.

Page 5, first full paragraph:

The thin arc segment magnet having a thickness of 1-4 mm according to one embodiment of the present invention is made of a rare earth sintered magnet having a main component composition comprising 28-33 weight % of R and 0.8-1.5 weight % of B, the balance being substantially Fe, wherein R is at least one [of] rare earth [elements] element including Y, and T is Fe or Fe and Co, the arc segment magnet having an oxygen content of 0.3 weight % or less based on the total weight of the magnet, a density of 7.56 g/cm^3 or more, a coercivity iHc of 1.1 MA/m (14 kOe) or more at room temperature, and an orientation $Br/4\pi I_{max}$ of 96% or more in an anisotropy-providing direction at room temperature.

Page 5, second full paragraph:

This arc segment magnet preferably has parallel anisotropy and a length of 40-100 mm in an axial direction. Further [a] the ratio I(105)/I(006) is preferably 0.5-0.8, wherein I(105) represents the intensity of an X-ray diffraction peak from a (105) plane, and I(006) represents the intensity of an X-ray diffraction peak from a (106) plane.

Page 5, paragraph bridging pages 5 & 6:

The radially anisotropic arc segment magnet having an inner diameter of 100 mm or less according to another embodiment of the present invention is made of a rare earth sintered magnet having a main component composition comprising 28-33 weight % of R and 0.5-1.5 weight % of B, the balance being substantially Fe, wherein R is at least one [of] rare earth [elements] element including Y, and T is Fe or Fe and Co, the arc segment magnet having an oxygen content of 0.3 weight % or less based on the total weight of the magnet, a density of 7.56 g/cm^3 or more, a

coercivity iHc of 1.1 MA/m (14 kOe) or more at room temperature, and an orientation [Br// / (Br// + Br⊥)] x 100 (%) of 85.5% or more at room temperature, the orientation being defined by a residual magnetic flux density Br// in a radial direction and a residual magnetic flux density Br⊥ in an axial direction perpendicular to the radial direction.

Page 6, first full paragraph:

This arc segment magnet is preferably as thin as 1-4 mm and as long as 40-100 mm in [an] <u>the</u> axial direction.

Page 6, second full paragraph:

The radially anisotropic ring magnet having an inner diameter of 100 mm or less according to a further embodiment of the present invention is made of a rare earth sintered magnet having a main component composition comprising 28-33 weight % of R and 0.8-1.5 weight % of B, the balance being substantially Fe, wherein R is at least one [of] rare earth [elements] <u>element</u> including Y, and T is Fe or Fe and Co, the ring magnet having an oxygen content of 0.3 weight % or less based on the total weight of the magnet, a density of 7.56 g/cm^3 or more, a coercivity iHc of 1.1 MA/m (14 kOe) or more at room temperature, and an orientation [Br// / (Br// + Br⊥)] x 100 (%) of 85.5% or more at room temperature, the orientation being defined by a residual magnetic flux density Br// in a radial direction and a residual magnetic flux density Br⊥ in an axial direction perpendicular to the radial direction. The ring magnet preferably has portions bonded by sintering.

Page 6, paragraph bridging pages 6 and 7:

The method for producing a rare earth sintered magnet according to the present invention comprises the steps of finely pulverizing an alloy for the rare earth sintered magnet to an average particle size of 1-10 μm in a non-oxidizing atmosphere; introducing the resultant fine powder into a mixture liquid comprising 99.7-99.99 parts by weight of at least one oil selected form the group consisting of a mineral oil, a synthetic oil and a vegetable oil and 0.01-0.3 parts by weight of a nonionic surfactant and/or an anionic surfactant; subjecting the resultant slurry mixture to molding in a magnetic field; and carrying out oil removal, sintering and heat treatment in this order. The rare earth sintered magnet preferably has a main phase composed of an $R_2T_{14}B$ intermetallic compound, wherein R is at least one [of] rare earth [elements] element including Y, and T is Fe or Fe and Co. The molding in a magnetic field is preferably compression molding, and the compressed green body preferably has a density distribution of 4.3-4.7 g/cm^3.

Page 7, second full paragraph:

Fig. 2 is a graph showing the relation between the type of a surfactant added to a slurry and [an] the oil content in a green body formed from the slurry;

Page 8, first full paragraph:

Fig. 10 is a graph showing the relation between the density of a green body for a radial ring and [a] the molding pressure;

Page 8, sixth full paragraph:

Fig. 14(a) is a view showing [a] the magnetic flux density distribution on the surface of the radial ring of the present invention having sintering-bonded portions; and

Page 8, ninth full paragraph:

The preferred composition of the first $R_2T_{14}B$-type, sintered magnet comprises 28-33 weight % of R and 0.8-1.5 weight % of B, the balance being substantially Fe, wherein R is at least one [of] rare earth [elements] element including Y, and T is Fe or Fe and Co.

Page 9, third full paragraph:

T is Fe or Fe + Co. The inclusion of Co improves [a] corrosion resistance and elevates [a] the Curie temperature, thereby improving the heat resistance of the $R_2T_{14}B$-type, sintered magnet. However, when the amount of Co exceeds 5 weight % based on the total weight of the magnet, Fe-Co phases harmful to magnetic properties are formed, resulting in a drastic decrease in Br and iHc. Accordingly, the amount of Co is preferably 5 weigh % or less. On the other hand, when the amount of Co is less than 0.5 weight %, effects of improving corrosion resistance and heat resistance cannot be obtained. Accordingly, the amount of Co is preferably 0.5-5 weight %.

Page 10, first full paragraph:

The amount of carbon contained as an inevitable impurity is preferably 0.10 weight % or less, more preferably 0.07 weight % or less, based on the total weight of the magnet. The reduction of [a] the carbon content suppresses the formation of rare earth carbides, resulting in an increase in iHc, $(BH)_{max}$, etc.

Page 10, second full paragraph:

The amount of nitrogen contained as an inevitable impurity is preferably 0.15 weight % or less, based on the total weight of the magnet. When the nitrogen content exceeds 0.15 weight %, Br decreases drastically. Incidentally, the lower limit of the nitrogen content is practically about 0.002 weight %. A surface treatment coating such as Ni plating, etc., is formed on the arc segment magnet and the ring magnet, and good corrosion resistance is achieved when the nitrogen content is 0.15 weight % or less.

Page 10, paragraph bridging pages 10 and 11:

The preferred composition of the second $R_2T_{14}B$-type, sintered magnet comprises 28-33 weight % of R, 0.8-1.5 weight % of B, and 0.6 weight % of M_1, the balance substantially Fe, wherein R and T are the same as in the first $R_2T_{14}B$-type, sintered magnet, and M_1 is at least one element selected from the group consisting of Nb, Mo, W, V, Ta, Cr, Ti, Zr and Hf. Because the second $R_2T_{14}B$-type, sintered magnet is the same as the first $R_2T_{14}B$-type, sintered magnet except for M_1, explanation will be made only on M_1 here.

Page 11, first full paragraph:

The amount of a high-melting point metal element M_1 is 0.6 weight % or less, preferably 0.01-0.6 weight %, to increase magnetic properties. With 0.6 weight % or less of M_1, the excess growth of main phase crystal grains is suppressed during the sintering process, thereby making it possible to stably achieve iHc of 1.1 MA/m (14 kOe) or more. However, when the M_1 content exceeds 0.6 weight %, the normal growth of main phase crystal grains is rather hindered,

resulting in decrease in Br. On the other hand when the M_1 content is less than 0.01 weight %, effects of M_1 improving magnetic properties cannot be obtained.

Page 11, paragraph bridging pages 11 and 12:

The amount of M_2 is 0.01-0.4 weight %. With respect to each element, the inclusion of A1 contributes to increase [in] iHc, resulting in improvement in corrosion resistance. When the amount of A1 is more than 0.3 weight %, Br decreases drastically. On the other hand, when the amount of A1 is less than 0.01 weight %, effects of improving iHc and corrosion resistance cannot be obtained. The inclusion of Ga contributes to remarkably increase iHc. When the amount of Ga is more than 0.3 weight %, Br decreases drastically. On the other hand, when the amount of Ga is less than 0.01 weight %, effects of improving iHc cannot be obtained. The inclusion of a trace amount of Cu contributes to improvement in corrosion resistance and increase in iHc. When the amount of Cu is more than 0.3 weight %, Br decreases drastically. On the other hand, when the amount of Cu is less than 0.01 weight %, effects of improving corrosion resistance and iHc cannot be obtained. When two or more of A1, Ga and Cu are contained, the amount of M_2 is their total amount.

Page 12, second full paragraph:

The first arc segment magnet of the present invention has an oxygen content of 0.3 weight % or less based on the total weight of the magnet, a density of 7.56 g/cm^3 or more, a coercivity iHc of 1.1 MA/m (14 kOe) or more at room temperature, and an orientation $Br/4\pi I_{max}$ of 96% or more in an anisotropy-providing direction at room temperature. Here, $4\pi I_{max}$ is the

maximum value of $4\pi I$ in a curve of $4\pi I$-H, wherein $4\pi I$ is the intensity of magnetization, [and] H is the intensity of a magnetic field, and Br is [a] the residual magnetic flux density.

Page 14, third full paragraph:

The fine pulverization of an alloy is carried out by a dry pulverization method or a wet pulverization method. The dry pulverization method is carried out by a jet mill, etc., in an inert gas atmosphere having an oxygen concentration of 0.1 % by volume or less, preferably 0.01 % by volume. The wet pulverization method is carried out by a wet ball mill, etc., under the non-oxidizing condition.

Page 16, line 3 (subtitle):

(C) Molding in a magnetic field

Page 16, paragraph bridging pages 16 and 17:

If the green body is rapidly heated from room temperature to a sintering temperature, oil remaining in the green body reacts with rare earth elements to form rare earth carbides, resulting in deterioration in magnetic properties. Thus, it is preferable to carry out an oil removal treatment by heating the green body at a temperature of 100-500°C and a vacuum degree of 13.3 Pa (10^{-1} Torr) or less for 30 minutes or longer. By this oil removal treatment, oil remaining in the green body is fully removed. Incidentally, as long as the oil removal treatment is within a temperature range of 100-500°C, it [needs] need not be conducted by a single, step, but may be conducted by a plurality of steps. Also, oil removal can be efficiently carried out[,] when a

temperature-elevating speed from room temperature to 500°C is preferably 10°C/minute or less, more preferably 5°C/minute or less.

IN THE CLAIMS:

The claims are amended as follows:

1. (Amended) A thin arc segment magnet having a thickness of 1-4 mm and made of a rare earth sintered magnet having a main component composition comprising 28-33 weight % of R and 0.8-1.5 weight % of B, the balance being substantially Fe, wherein R is at least one [of] rare earth [elements] element including Y, and T is Fe or Fe and Co, said arc segment magnet having an oxygen content of 0.3 weight % or less based on the total weight of the magnet, a density of 7.56 g/cm^3 or more, a coercivity iHc of 1.1 MA/m (14 kOe) or more at room temperature, and an orientation $Br/4\pi I_{max}$ of 96% or more in an anisotropy-providing direction at room temperature.

5. (Amended) A radially anisotropic, arc segment magnet having an inner diameter of 100 mm or less and made of a rare earth sintered magnet having a main component composition comprising 28-33 weight % of R and 0.8-1.5 weight % of B, the balance being substantially Fe, wherein R is at least one [of] rare earth [elements] element including Y, and T is Fe or Fe and Co, said arc segment magnet having an oxygen content of 0.3 weight % or less based on the total weight of the magnet, a density of 7.56 g/cm^3 or more, a coercivity iHc of 1.1 MA/m (14 kOe) or more at room temperature, and an orientation [Br// / (Br// + Br⊥)] x 100 (%) if 85.5% or more at room temperature, said orientation being defined by a residual magnetic flux

density Br// in a radial direction and a residual magnetic flux density Br⊥ in an axial direction perpendicular to said radial direction.

8. (Amended) A radially anisotropic ring magnet having an inner diameter of 100 mm or less made of a rare earth sintered magnet having a main component composition comprising 28-33 weight % of R and 0.8-1.5 weight % of B, the balance being substantially Fe, wherein R is at least one [of] rare earth [elements] <u>element</u> including Y, and T is Fe or Fe and Co, said ring magnet having an oxygen content of 0.3 weight % or less based on the total weight of the magnet, a density of 7.56 g/cm^3 or more, a coercivity iHc of 1.1 MA/m (14 kOe) or more at room temperature, and an orientation [Br// / (Br// + Br⊥)] x 100 (%) of 85.5% or more at room temperature, said orientation being defined by a residual magnetic flux density Br// in a radial direction and a residual magnetic flux density Br⊥ in an axial direction perpendicular to the radial direction.

11. (Amended) The method for producing a rare earth sintered magnet according to claim 10, wherein the molding in a magnetic field is compression molding, and the compressed green body preferably has density distribution of 4.3-4.7 g/cm^3 to provide a rare earth sintered magnet having a main phase composed of an $R_2T_{14}B$ intermetallic compound, wherein R is at least one [of] rare earth [elements] <u>element</u> including Y, and T is Fe or Fe and Co.

12. (Amended) A method for producing a thin arc segment magnet having thickness of 1-4 mm and made of a rare earth sintered magnet having a main component

composition comprising 28-33 weight % of R and 0.8-1.5 weight % of B, the balance being substantially Fe, wherein R is at least one [of] rare earth [elements] <u>element</u> including Y, and T is Fe or Fe and Co, said arc segment magnet having an oxygen content of 0.3 weight % or less based on the total weight of the magnet, a density of 7.56 g/cm^3 or more, a coercivity iHc of 1.1 MA/m (14 kOe) or more at room temperature, and an orientation $Br/4\pi I_{max}$ of 96% or more in an anisotropy-providing direction at room temperature, said method comprising the steps of finely pulverizing an alloy for said rare earth sintered magnet to an average particle size of 1-10 μm in a non-oxidizing atmosphere; introducing the resultant fine powder into a mixture liquid comprising 99.7-99.99 parts by weight of at least one oil selected from the group consisting of a mineral oil, a synthetic oil and a vegetable oil and 0.01-0.3 parts by weight of a nonionic surfactant and/or an anionic surfactant; subjecting the resultant slurry mixture to molding in a magnetic field; and carrying out oil removal, sintering and heat treatment in this order.

13. (Amended) A method for producing a radially anisotropic, arc segment magnet having an inner diameter of 100 mm or less and made of a rare earth sintered magnet having a main component composition comprising 28-33 weight % of R and 0.8-1.5 weight % of B, the balance being substantially Fe, wherein R is at least one [of] rare earth [elements] <u>element</u> including Y, and T is Fe or Fe and Co, said arc segment magnet having an oxygen content of 0.3 weight % or less based on the total weight of the magnet, a density of 7.56 g/cm^3 or more, a coercivity iHc of 1.1 MA/m (14 kOe) or more at room temperature, and an orientation [Br// / (Br// + Br⊥)] x 100 (%) of 85.5% or more at room temperature, said orientation being defined by a residual magnetic flux density Br// in a radial direction and a residual magnetic flux density

Br⊥ in an axial direction perpendicular to said radial direction, said method comprising the steps of finely pulverizing an alloy for said rare earth sintered magnet to an average particle size of 1-10 μm in a non-oxidizing atmosphere; introducing the resultant fine powder into a mixture liquid comprising 99.7-99.99 parts by weight of at least one oil selected from the group consisting of a mineral oil, a synthetic oil and a vegetable oil and 0.01-0.3 parts by weight of a nonionic surfactant and/or an anionic surfactant; subjecting the resultant slurry mixture to molding in a magnetic field; and carrying out oil removal, sintering and heat treatment in this order.

14. (Amended) A method for producing a radially anisotropic ring magnet having an inner diameter of 100 mm or less and made of a rare earth sintered magnet having a main component composition comprising 28-33 weight % of R and 0.8-1.5 weigh t% of B, the balance being substantially Fe, wherein R is at least one [of] rare earth [elements] <u>element</u> including Y, and T is Fe or Fe and Co, said ring magnet having an oxygen content of 0.3 weight % or less based on the total weight of the magnet, a density of 7.56 g/cm^3 or more, a coercivity iHc of 1.1 MA/m (14 kOe) or more at room temperature, and an orientation [Br// / (Br// + Br⊥)] x 100 (%) of 85.5% or more at room temperature, said orientation being defined by a residual magnetic flux density Br// in a radial direction and a residual magnetic flux density Br⊥ in an axial direction perpendicular to the radial direction, said method comprising the steps of finely pulverizing an alloy for said rare earth sintered magnet to an average particle size of 1-10 μm in a non-oxidizing atmosphere; introducing the resultant fine powder into a mixture liquid comprising 99.7-99.99 parts by weight of at least one oil selected from the group consisting of a mineral oil, a synthetic oil and a vegetable oil and 0.01-0.3 parts by weight of a nonionic surfactant and/or an anionic

surfactant; subjecting the resultant slurry mixture to molding in a magnetic field; and carrying out oil removal, sintering and heat treatment in this order.

IN THE ABSTRACT OF DISCLOSURE:

The abstract is changed as follows:

A thin arc segment magnet made of a rare earth sintered magnet substantially comprising 28-33 weight % of R and 0.8-1.5 weight % of B, the balance being substantially Fe, wherein R is at least one [of] rare earth [elements] element including Y, and T is Fe or Fe and Co, which has an oxygen content of 0.3 weight % or less, a density of 7.56 g/cm^3 or more, a coercivity iHc of 1.1 MA/m (14 kOe) or more at room temperature, and an orientation $Br/4\pi I_{max}$ of 96% or more in an anisotropy-providing direction at room temperature can be produced by using a slurry mixture formed by introducing fine alloy powder of the above composition into a mixture liquid comprising 99.7-99.99 parts by weight of a mineral oil, a synthetic oil or a vegetable oil and 0.01-0.3 parts by weight of a nonionic surfactant and/or an anionic surfactant.